LIfE: Luminescence Imager for Exploration

Completed Technology Project (2017 - 2019)

Project Introduction

NASA Ames Research Center (ARC) will mature a microfluidic-based fluorescence imaging microscope for the detection and study of biomarkers and structural indicators of microbial life in icy world environments. The Luminescence Imager for Exploration (LIfE) instrument is a microfluidic platform designed for biostructure fluorescence imaging using deep-ultraviolet (DUV) and visible light excitation. LIfE heritage is derived from the Fluorescence Analysis for In-situ Research on Nanosatellites (FLAIR) imager developed at ARC for the the study of C. elegans in Low Earth Orbit. LIfE will leverage ARC nanosatellite fabrication capabilities including stringent sterility and cleanliness requirements as well as general microfluidic design, development, fabrication, integration, sterilization, and test approaches. Although the current TRL of FLAIR is 6, in the context of an integrated system for icy world exploration, the current TRL of LIfE is 3, driven by its lowest TRL subsystems. Under this COLDTech, LIfE will be matured to an end-to-end system with a project exit TRL of 5. LIfE will collect samples onto a sub-micron filter and analyze them using fluorescence imaging with sub-micron spatial resolutions enabling the detection and quantification of bacterium-sized structures. During analysis of the samples, LIfE will operate using two modes of fluorescence analysis: 1) Utilizing fluorescence stains specific to key structural biomarkers, i.e., typical membrane constituents such as fatty acids, phospholipid bilayers, and membrane proteins. 2) Using DUV and visible light-emitting diodes (LEDs) for the excitation of native luminescence in the samples. The inclusion of a DUV-excitation source will allow LIfE to operate without the use of stains which may not bind to the structural components of extraterrestrial life forms. LIfE directly addresses the goals of future NASA missions by providing life detection technology suitable for flyby, orbital, and landed missions and multiple payloads and payload implementations. LIfE directly addresses the COLDTech program through the development of a spacecraft-based instrument for surface and subsurface exploration of ocean worlds such as Europa and Enceladus. LIfE is directly applicable to the Europa lander mission concept as described in the COLDTech Announcement of Opportunity. LIfE addresses NASA Planetary Science Division's strategic goals and objectives and is focused on the detection of extant life in the "Ocean Worlds" of the outer Solar System.

Anticipated Benefits

This project will result in new NASA technology for life detection that is suitable for flyby, orbital, and landed missions, and multiple payload implementations. This spacecraft-based instrument technology targets future surface and subsurface exploration of ocean worlds such as Europa and Enceladus.

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Table of Contents

Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Responsible Program:

Concepts for Ocean Worlds Life Detection Technology

LIfE: Luminescence Imager for Exploration

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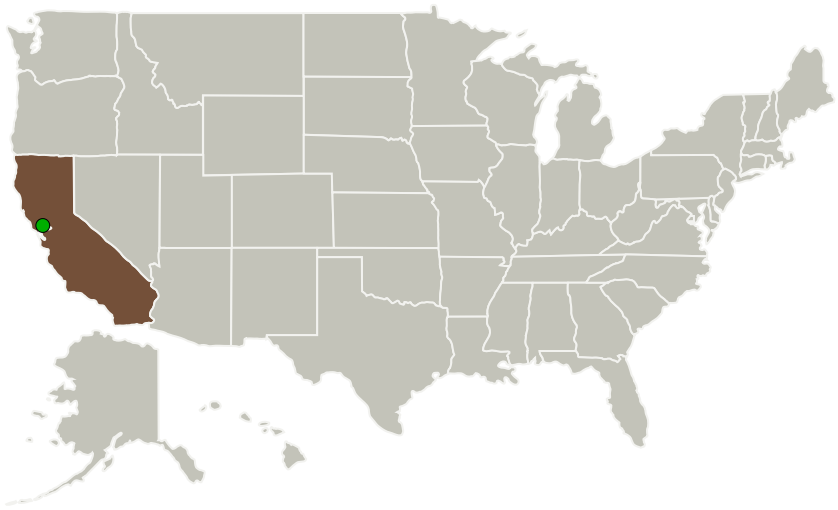
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations
California

Project Management

Program Director:
Carolyn R Mercer

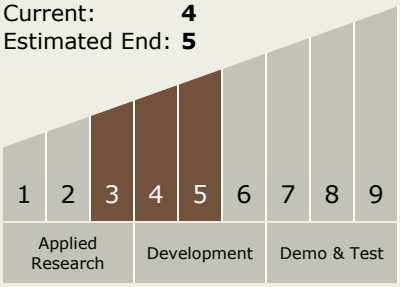
Program Manager:
Carolyn R Mercer

Principal Investigator:
Richard C Quinn

Co-Investigators:
Nathan E Bramall
Sandra Owen
Linda R Timucin
Antonio J Ricco
Christopher P Mckay
Kathryn F Bywaters
Mary N Parenteau
Alfonso F Davila

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **5**



Technology Areas

Primary:

- TX08 Sensors and Instruments

Continued on following page.

Technology Areas *(cont.)*

- TX08.3 In-Situ Instruments and Sensors
  - TX08.3.4 Environment Sensors

Target Destination

Others Inside the Solar System